DSC 461, HW#3, Kefu Zhu

Problem 1

(1) **Initialize Matrix S**

	A	B	C	D	E
R_1	a_1	a_2	a_3	b_{14}	b_{15}
R_2	a_1	b_{12}	b_{13}	a_4	a_5

(2) **Apply FD**

	A	B	C	D	E
R_1	a_1	a_2	a_3	a_4	a_5
R_2	a_1	a_2	a_3	a_4	a_5

Because both rows are made up entirely of a symbols, the decomposition is a lossless-join

Problem 2

Write an SQL query to test whether the functional dependency $b \rightarrow c$ holds on relation r

```
SELECT IF((SELECT COUNT(*)
           FROM r AS r1, r AS r2
           WHERE r1.b = r2.b AND r1.c != r2.c)
           = 0),
           'Functional dependency of b to c holds.',
           'Functional dependency of b to c DOES NOT hold.');
```

Write an SQL assertion that enforces the functional dependency. Assume that

no null values are present

```
CREATE ASSERTION FD_b_to_c
CHECK (NOT EXISTS (SELECT *
                   FROM r AS r1, r AS r2
                   WHERE r1.b = r2.b AND r1.c != r2.c
                  ));
```

Problem 3

What are all the keys for Courses?

(1) **Initialize K**

$K = \{C, T, H, R, S, G\}$

(2) **For each attribute in K, determine whether it can be determined by the rest of attributes**

- C can be determined by HR, remove C from K. Reset $K = \{T, H, R, S, G\}$
- T can be determined by HR because $\{HR \rightarrow C, C \rightarrow T\} \Rightarrow \{HR \rightarrow T\}$. Reset $K = \{H, R, S, G\}$
- H cannot be determined by any attributes in K
- R can be determined by HS. Reset $K = \{H, S, G\}$
- S cannot be determined by any attributes in K
- G can be determined by HS because $CS \rightarrow G$ and C can be determined by HR, where R can be determined by HS. Reset $K = \{H, S\}$

Answer: Key for Courses is $\{H, S\}$

Is the given set F of FD's a minimal cover for F itself? Explain.

(1) **Reduce all FDs in canonical form**

Since every FDs has only one attribute on the right hand side, all FDs are in canonical form.

(2) **For each FD, X→A, reduce it to (X-{B})→A if possible**

- $C \rightarrow T$, cannot be reduced
- $HR \rightarrow C$, cannot be reduced to $H \rightarrow C$ or $R \rightarrow C$
- $HT \rightarrow R$, annot be reduced to $H \rightarrow R$ or $T \rightarrow R$
- $HS \rightarrow R$, annot be reduced to $H \rightarrow R$ or $S \rightarrow R$

- $CS \to G$, annot be reduced to $C \to G$ or $S \to G$

(3) **Remove any redundant FD**

None of the FDs is redundant

Answer: The given set F of FD is a minimal cover for F itself

Use the 3NF algorithm discussed in lecture to find a lossless-join, dependencypreserving decomposition of R into 3NF relations.

(1) **Find minimal cover G for F**

$$G = \{C \to T, HR \to C, HT \to R, HS \to R, CS \to G\}$$

(2) **Create relation**

- $R_1 = \{C, T\}$
- $R_2 = \{H, R, C\}$
- $R_3 = \{H, T, R\}$
- $R_4 = \{H, S, R\}$
- $R_5 = \{C, S, G\}$

Where we have R_4 that contains the keys $\{H, S\}$

(3) **Remove redundant relation**

None of the relations is redundant.

Answer the decomposition of R into 3NF relations are

- $R_1 = \{C, T\}$
- $R_2 = \{H, R, C\}$
- $R_3 = \{H, T, R\}$
- $R_4 = \{H, S, R\}$
- $R_5 = \{C, S, G\}$